Exploration of Disparities in Environmental Activities of European Countries from Year 2006 to Year 2016

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The main aim of the study is to investigate and to evaluate the disparities in the environmental activities of the European countries in the time period from the year 2006 to the year 2016. The data from the Eurostat database is applied. Regarding the character of the data and the target orientation of the study, the cluster analysis is selected in order to reveal the desired relations. The analysis outcome point to several interesting facts. The distribution of the countries among the clusters is very uneven. The participants behave considerably differently. For instance, Austria belongs to the largest clusters in all but one explored fields, although its output is not very similar to the remaining countries. This reveals inefficiency that should be a subject of further research. The obtained findings enable to carry out a structural analysis of the environmental activities under investigation and to define causal relationships and research trajectories that would reflect the extent of economic and legislative measures in place in each country, the demographic structure impacts on environmental activities, and economic subsystems in the country, causes of environmental disparities within countries, etc. The results of the study are particularly relevant for national and international environmental policymakers, as well as for the concept of regional development plans and the development of monitoring and evaluation mechanisms.

Keywords: *environmental activity, environmental indicator, environmental protection, cluster analysis, dendrogram, Euclidean distance.*

Introduction

The environmental indicators are usually applied to assess efficiency and effectiveness of the environmental activities in the individual countries. They support the processes of planning, setting strategic goals as well as developing measures and instruments in the regional development concepts of the countries. The environmental indicators are part of the monitoring and decision-making mechanisms and systems. Their important role also lies in signalling economic, social and environmental threats. Many international organisations focus on developing indicator groups to assess the environmental aspects and to implement them into practice as, for instance, the Organisation for Economic Co-operation and the United Nations. The first published indicator group is the Organisation for Economic Co-operation Core Set of Indicators for Environmental Performance in the year 1993 (Organisation for Economic Co-operation, 1993). It was later innovated in the year 2001 (Organisation for Economic Co-operation, 2001) and in the year 2003 (Organisation for Economic Co-operation, 2003). Gradually, the groups of the indicators were developed for transport, energy, agriculture, and household consumption. Another group of the indicators of this institution are the indicators derived from the environmental accounting consists of the three parts, which pollution abatement and control expenditure, natural resource accounts, and environmental accounting belong among. By introducing these indicators, it is possible to monitor and to evaluate developments in these environmental areas and to compare the achievements in the individual Organisation for Economic Co-operation member countries over the previous two decades. The further development of the environmental indicators is accompanied by the adoption of the new strategies. For instance, the so-called green growth strategy from the year 2009 is adopted to support the economic growth and development of the countries while providing ecosystem services (Organisation for Economic Co-operation, 2011). It underlines the need for investment and innovation support as well as for competition that has a positive impact on sustainable growth and the creation of new labour positions usually. Green growth provides both a policy strategy for economic transition and a monitoring framework with a proposed set of indicators. It connects the economic and environmental context (Guštafíková et al., 2014). All the activities in the field of environmental protection by the year 2020 emphasise the importance of the transition to a greener and more cyclical economy. The development of the new groups of the indicators is often complicated, and this construction of the composite indicators impede international comparison, which may also reveal the reasons for the national disparities in some environmental areas. Therefore, it is important to continuously develop national and international registers that would contain retrospective as well as up-to-date data declaring the current state in the environmental policies of the countries and the effectiveness of the intervention measures. This also allows causal relationships between changes in the environmental characteristics of the individual geographical areas and their impact on the economic and social spheres. This is also an incentive to carry out the introduced research, which is based on the data from Eurostat, in order to analyse and to evaluate the disparities in the environmental activities of the European countries in the time period from the year 2006 to the year 2016.

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The structure of the study is as follows – the literature review of the research studies is focused on the exploration of the use the environmental indicators – whether separately, or in groups – in order to assess the individual areas of the environment and the implications in the several types of the policies. This allows defining the research framework. In order to process the values of the indicators aimed at assessing the environmental activities of the individual countries, the cluster analysis is applied to demonstrate the disparities between the countries in the examined areas. The analysis outcome creates a platform for formulating the discussion framework and the research conclusions. Also, the ideas for the potential subsequent research in this area are specified.

Literature Review

Many national and international types of research focus on monitoring and assessing the environmental activities in particular countries with specific causal links to the socio-economic and demographic spheres of interest. The environmental activities are carried out in the legislative frameworks, which also create a platform for setting up regulatory and stabilisation mechanisms in the area of environmental, economic and social policies.

The available research studies dealing with the explored issue are largely heterogeneous in their content, which is determined by the aim of the presented researches, the aspects examined as well as the methodological backgrounds. Most of them have a strongly implied nature with links to many types of policies and thus, encouraging not only research teams to carry out the following research, but they also create the supporting mechanisms for a more in-depth examination of the various environmental determinants.

Wang et al. (2020) focus in their study on the performance of municipal solid waste management in Nottingham by analysing the material flows as well as the appropriately selected indicators based on the concept of the waste hierarchy and the objectives set out in the waste management regulations. The authors analyse improvements in waste reduction, material recycling, energy recovery and landfill prevention. The results of the study declare the fulfilment of the high ambitious goals set by the local government, while the authors call for the creation of the new improvement programmes. These can be achieved by setting up an education system as well as through promotion of public waste separation. The environmental activities are often linked to the competitiveness of a particular country as well as business performance (Rajnoha et al., 2017). Agovino et al. (2020) examine the relationship between the recycling rates achieved and the competitiveness of the enterprises operating in the circular economy sectors. The results of the study clearly declare the positive impact between packaging recycling, electronic and biological waste recycling rates and the competitiveness of the companies involved. The authors examined this research trajectory across the 17 European countries through the data from the period from the year 2010 to the year 2016. The results show the clear differences between the countries too. Some authors evaluate environmental aspects not only separately, but also in the form of the composite indicators, monitoring related indicators respectively. Kikas et al. (2018) explore the possibility of using an expert system for mapping high nature value agricultural land in Estonia. The authors selected the 20 suitable indicators from the four thematic groups. Their methodology is also applicable in the other countries, and the map created should benefit agricultural policymakers to identify zones of high biodiversity where the suitable environmental schemes can be used. The study has a strong implication output for a policymaking process. Also, in the study by Biasi et al. (2019), the analytical trajectories are aimed at supporting the environmental policies. The authors point out the objectives of the national governments to promote the responsible management of natural capital. Therefore, in their study, they propose an extended version of the genuine saving macroeconomic indicator to account for water and soil depletion (Hamilton, 2000). As natural capital is spatially heterogeneous, the selected indicator is estimated for Italy for the period from the year 2000 to the year 2015 at the regional level. Although the study is conducted in Italy, the methodological framework is generally applicable to other countries as well. The methodological contribution suggests that genuine saving can support policymakers in developing the targeted policies for sustainable growth. Also, Tasser et al. (2019) deal with regional development and biodiversity protection. Agricultural, environmental, and climate measures create a central tool of the European Union to support its biodiversity conservation policy. In their study, the authors show a system for assessing agricultural land through a set of indicators related to the various aspects of biodiversity. They apply the evaluation system to the selected 44 farms in Austria, France, Germany, Italy, and Switzerland. The proposed system can serve as a tool to detect differences in biodiversity resulting from land-use practices. The results have an impact on the setting up of educational activities and agricultural advisory services.

Ribeiro et al. (2015) deal with the issue of the removal of organic micropollutants in the environment. In this study, the analytical methods are presented for the trace quantification of the 37 micropollutants including the priority substances meaning the substances of the recent watch list and the contaminants of emerging concern, which pesticides, multiclass pharmaceuticals, metabolites, estrogens and other industrial compounds belong among. The validated method is applied to wastewater treatment plant samples that assess the concentration of micropollutants after secondary biological and tertiary ultraviolet treatment. The results of the study also create a platform for potential following research and networking of international research teams in sharing experience in the application of the selected analytical methods to achieve the best performance in the removal of most of the determined micropollutants. McMahon et al. (2019) address in their study the recycling processes and their relevance in the framework of the emerging waste and recycling management legislation. The nature of many raw materials for the production of electrical and electronic equipment is critical and classified as hazardous waste. The authors use the results of interviews with the stakeholders of the involved enterprises on the reuse of waste electrical and electronic equipment in the year 2006 in Austria, Belgium, France, and the United Kingdom, where these systems are used and considered very successful. Even in Ireland, this system has evolved, but it has not yet been implemented. Spain as the first country in the European Union to have deemed preparation for reuse targets separate to those ones which are aimed at recycling in a necessary way. The authors define the elementary factors of the successful preparation for reuse in general involving social enterprise. Hermoso et al. (2020) explore alternative regional planning scenarios at the European Union level in the area of green infrastructure. The European Union Strategy on Green Infrastructure aims at developing a strategically planned network of natural areas to support the maintenance of ecosystem services and thus, to connect protected areas by promoting in this way through multifunctional landscapes. The authors test the two alternative spatial planning scenarios for the design of the network that would ensure support for the maintenance of the ecosystem services and the integration of protected areas. The results highlight the benefits of international cooperation in regional planning and the need to develop appropriate policy instruments to support ecosystem services as well as their integration into sectoral policies and funding systems. In addition to the studies dealing with separate environmental aspects or process areas directly linked to the environmental characteristics of the countries, some authors examine the efficiency of the countries in the terms of environmental efficiency (Zofio and Prieto, 2001; Zhou et al., 2007; Zhou et al., 2016; Gavurova et al., 2017). Halkos and Petrou (2019) examine the environmental efficiency of the 28 European Union member countries for the years 2008, 2010, 2012, and 2014 through the data envelopment analysis and the directional distance function to tackle the undesirable outputs. The eight parameters are applied – namely municipal solid waste generation, employment rate, capital formation, gross domestic product, population density and for the first time sulphur oxide, nitrogen oxide, and greenhouse gases emissions from the waste sector for the relevant countries. The results demonstrate that the most efficient countries are Germany, Ireland, and the United Kingdom. This outcome is reviewed against the recycling rate of each country for the examined time periods. The recycling rate actually depicts the data envelopment analysis results. Especially, more efficient countries seem to have a higher recycling rate too. Moreover, its efficiency results are contrasted to the overall treatment options used in the countries under consideration. Overall, it is noticed that countries employing all four treatment options with high use of more sustainable treatment and decrease in the use of landfill are the ones that also prove to be efficient according to the data envelopment analysis. As the authors point out, these results demonstrate a reflection of the financial crisis that forces countries to look for ways to move to a circular economy and to set production processes to minimise waste generation. The study has valuable outputs for policymakers, both nationally and internationally. It offers a platform to modify the European Union legislation and the directives in order to achieve a strategic direction for the European countries to the circular economy. The importance of investigating the effects of the environmental factors is not only related to economic and socio-economic areas. The population health directly affects the economic system of the country not only through the productivity indicators but also through the social indicators. The sustainability of the health and the social systems in the demographic ageing processes of the countries is also addressed. For this reason, in the last decade, many research teams have quantified the impact of the environmental factors on the population health and thus, to seek to economically assess the ecological burden of the particular country, including the impact on the health indicators and their causal links.

Alguquerque et al. (2017) examine the impact of industrial and agricultural activities on soil quality in their study. The authors report that potentially toxic elements pose a threat to public health and the environment. According to them, the strict definition of the critical areas requiring restore is crucial. Kupiec et al. (2019) investigate soil contamination with trace elements and fluoride in the selected location in Poland, where economic activity has historically been associated with the use of trace metals. The results of the study point to the fact that land in the places of extinct metalworking enterprises can still be an important source of trace metals. The research done has also shown an increased concentration of fluoride in the surface layers of soil. Mataloni et al. (2016) examine the health impacts associated with staying near landfills. They evaluate the possible effects of the concentration of hydrogen sulphide from landfills on the health of the population in the central part of Italy. There are the 9 landfill sites available; the analysed group is located within 5 km of the landfills. Šedová (2016) link the determinants of illegal landfilling to the economic and socio-economic indicators. She investigated illegal landfills at the regional level in Slovakia. The results of the study show that a higher level of the expected waste production results in a higher rate of illegal landfills and also their higher volume. Higher-income has a positive impact on the illegal landfill rate, whilst poverty affects them negatively. Higher levels of education do not lead to more responsible waste management. The results of this study clearly correlate with the results of Martuzzi et al. (2009), whose aim is to assess the possible adverse health effects of uncontrolled landfills in Italy. The authors point out the negative health impacts of the environmental exposures related to waste in the region of Campania, paying attention to the 9 causes of death and the 12 types of the congenital anomalies. The increased risks of cancer deaths for both sexes are identified. The congenital anomalies of the urogenital system and central nervous system are reported too. Festin et al. (2019) confront the impacts of mining on landscape changes related to the discharge of large quantities of waste, which have an impact on environmental pollution and harm to human health. Their study confirms the fact that over the last two decades, there has been an increase in interest in research into the recovery of the land after mining, which several techniques have been examined in. The authors point out the significant regional disparities in the knowledge base and in the implementation of the procedures aimed at the recovery of the mining sites. Insufficient attention focused on the elimination of these disparities may have significant negative economic and noneconomic impacts in the future – for instance, related to health, population migration, etc.

Data and Methodology

The applied methodological approaches are selected in order to obtain the desired aim set to carry out the analysis.

Data. The data comes from Eurostat – the statistical office of the European Union. The data set Production of environmental protection services of general government by economic characteristics marked env_ac_pepsgg serves as the source data set for the analysis (Eurostat, 2020). It describes a situation in the 31 countries throughout the period beginning in the year 2006 and ending in the year 2016 from a yearly perspective. The start of the observed period is determined by the accessibility of the data. This year is available almost for all the then European Union member countries. The remaining participate countries possess a shorter time period. Also, because of this fact, in order to achieve the same conditions for all the participants, the mean value of the explored dimensions is applied in the further analytical process. The observed data set to cover the data for all the environmental activities and for all the sections of the environmental activities too.

These six sections involve subsequent fields:

- protection of air, climate, soil, water and against noise, vibration, and radiation;
- wastewater management;
- waste management;
- protection of biodiversity and landscapes;
- environmental research and development;
- other environmental protection activities.

For all the mentioned sections, the following dimensions are observed:

- output;
- market output;
- nonmarket output;
- gross fixed capital formation and acquisitions;
- compensation of employees.

All the numbers are expressed in a money form denominated in the euro currency.

The explored countries are marked by the abbreviations according to the International Organization for Standardization 3166 standard Codes for the representation of names of countries and their subdivisions – the two-letter alpha-2 codes are applied particularly: AT – the Republic of Austria, BE – the Kingdom of Belgium, BG – the Republic of Bulgaria, CH – the Swiss Confederation, CZ – the Czech Republic, DE – the Federal Republic of Germany, DK – the Kingdom of Denmark, EE – the Republic of Estonia, ES – the Kingdom of Spain, FI – the Republic of Finland, FR – the French Republic, GB – the United Kingdom of Great Britain and Northern Ireland, GR – the Hellenic Republic, HR – the Republic of Croatia, HU – Hungary, IE – the Republic of Ireland, IT – the Italian Republic, LT – the Republic of Lithuania, LU – the Grand Duchy of Luxembourg, LV – the Republic of Latvia, MT – the Republic of Malta, NL – the Kingdom of the Netherlands, NO – the Kingdom of Norway, PL – the Republic of Poland, PT – the Portuguese Republic, RO – Romania, RS – the Republic of Serbia, SE – the Kingdom of Sweden, SI – the Republic of Slovenia, SK – the Slovak Republic, and TR – the Republic of Turkey (International Organization for Standardization).

Methodology. The main technique applied in the analysis is cluster analysis. The hierarchical clustering approach is applied (Hartigan, 1975; Hartigan, 1983). Its outcome is visualised in the form of the matrix of the mutual distances of the individual pairs of the explored countries that expresses their similarities and in the form of the dendrogram that illustrates the similarity of the produced clusters. The similarity is quantified by the Euclidean distance method.

The number of clusters is determined by the tau index (Rohlf, 1974; Milligan, 1981). The same number is applied in all the clustering process in the analysis. It is based upon the whole data set.

The elementary formula of the tau index is as follows:

$$\tau = \frac{CC - DC}{\sqrt{\frac{D(D-1)}{2(2-C)}}} \qquad (1)$$

where the involved variables mean:

– τ – a tau value;
– CC – a number of the concordant comparisons;
– DC – a number of the disconcordant comparisons;
– D – the total distances;
– C – a number of the comparisons when two pairs of the points representing comparison within the cluster or between the clusters.

Analysis

The whole analysis is divided into seven sections. The first section is the fundamental section based on an analysis of the whole data set, covering all the environmental protection activities. Then, all the environmental protection activities are next. Successively, the six sections involving the particular fields mentioned in the Data and Methodology section follow.

Overall View. Firstly, an overall view of the scrutinised topic is offered. This serves as a reference outcome for the subsequent analysis.

The following table demonstrates the similarities between the analysed countries based on all the sections of the environmental protection activities.

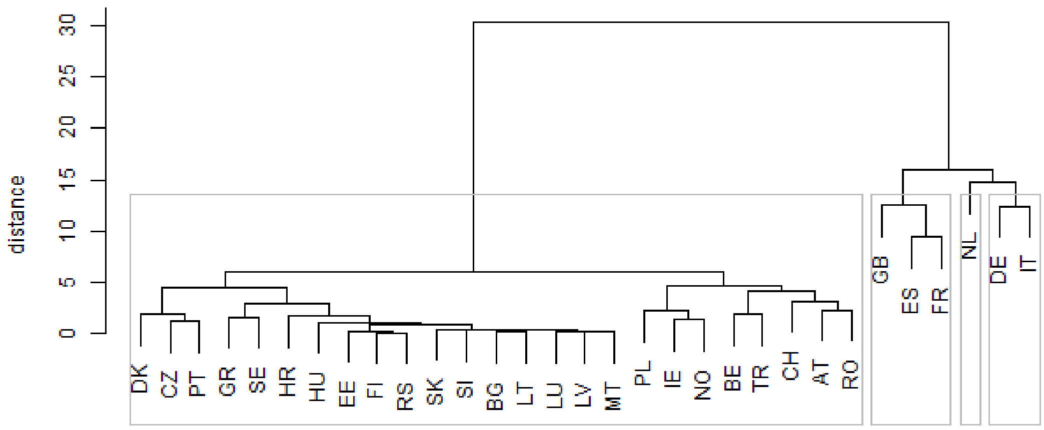


Fig. 1: The Dendrogram of All the Individual Sections
Source: own elaboration by the authors.

As it is seen from the figure, the division of the countries is uneven. The largest cluster involves the 25 countries – as they are illustrated by the dendrogram Denmark, Czechia, Portugal, Greece, Sweden, Croatia, Hungary, Estonia, Finland, Serbia, Slovakia, Slovenia, Bulgaria, Lithuania, Luxembourg, Latvia, Malta, Poland, Ireland, Norway, Belgium, Turkey, Switzerland, Austria, and Romania. The second cluster consists of the three countries where the United Kingdom of Great Britain and Northern Ireland, Spain, and France belong. The third cluster is created by only a sole country – the Netherlands. The fourth cluster involves the two countries – Germany and Italy. The whole division of the countries is considerably unproportional. This is caused by very high disparities between the well-developed countries and the remaining ones. Also, there is visible a very sharp patter in the first cluster. At a level of distance of approximately over five Euclidean units, this cluster could be divided into to two groups unconditionally. But, as the disparities among the observed countries are high, this inequality is not so high in order to distinguish the separate clusters. The same note can be applied to the further classification of the countries within these imaginary groups.

Tab. 1: The similarity Matrix of the Explored Countries

Country	AT	BE	BG	CH	CZ	DE	DK	EE	ES	FI	FR	GB	GR	HR	HU	IE	IT	LT	LU	LV	MT	NL	NO	PL	PT	RO	RS	SE	SI	SK	TR
AT	0	2.74	2.25	2.44	2.98	2.84	14.50	2.25	6.99	2.67	15.09	11.51	2.66	2.13	2.30	2.58	14.02	2.22	2.21	2.16	2.24	13.39	3.08	3.18	3.51	2.36	2.68	2.40	2.02	2.13	3.19
BE	2.74	0	4.08	2.91	3.62	3.47	13.14	3.29	5.83	4.34	14.05	10.07	3.64	2.85	3.92	4.17	12.48	4.13	4.10	4.07	4.16	12.05	3.56	3.38	4.13	3.67	2.98	3.00	4.05	3.04	1.95
BG	2.25	4.08	0	3.79	1.52	2.71	15.56	0.46	7.82	0.73	15.66	12.32	1.75	1.36	0.64	2.32	13.86	0.22	0.35	0.31	0.27	14.30	2.60	2.81	2.80	2.26	0.42	1.87	0.35	0.34	2.77
CH	2.44	2.91	3.79	0	3.44	3.64	14.67	3.95	5.65	3.96	10.06	10.99	3.32	3.85	3.55	3.68	15.59	3.84	3.93	3.90	3.93	11.73	3.48	3.57	3.42	3.51	4.26	2.53	3.72	3.65	3.40
CZ	2.98	3.62	1.52	3.44	0	1.76	15.96	1.86	6.85	1.72	11.91	12.76	2.14	2.39	1.17	2.83	14.72	1.60	1.62	1.69	1.67	13.46	2.60	2.65	1.22	2.93	1.80	1.99	1.54	1.60	2.33
DE	2.84	3.47	2.71	3.64	1.76	0	14.45	2.54	6.81	2.02	14.68	11.86	3.22	2.64	2.60	3.34	12.64	2.69	2.62	2.66	2.71	13.09	3.32	3.06	1.81	3.36	1.75	2.34	2.54	2.55	2.43
DK	14.50	13.14	15.56	14.67	15.96	14.45	0	15.57	12.43	16.65	12.32	14.73	15.29	14.83	15.25	14.65	12.46	15.55	15.56	15.59	15.64	13.24	14.04	13.58	15.08	15.04	16.28	15.73	15.53	15.35	15.68
EE	2.25	3.29	0.46	3.95	1.86	2.54	15.57	0	7.55	0.14	15.50	11.59	1.61	1.40	1.01	1.89	14.78	0.41	0.34	0.40	0.35	14.73	2.63	3.13	2.87	2.58	0.30	2.05	0.48	0.53	2.88
ES	6.99	5.83	7.82	5.65	6.85	6.81	12.43	7.55	0	7.87	9.47	9.99	7.06	7.31	7.55	7.47	10.40	7.99	7.78	7.88	7.90	11.77	6.60	6.91	6.88	7.92	7.11	6.04	7.87	7.16	5.32
FI	2.67	4.34	0.73	3.96	1.72	2.02	16.65	0.14	7.87	0	12.88	13.32	2.27	1.61	1.17	2.66	15.42	0.64	0.68	0.66	0.69	14.08	3.02	2.95	1.24	2.72	0.11	2.03	0.70	0.47	2.87
FR	15.09	14.05	15.66	10.06	11.91	14.68	12.32	15.50	9.47	12.88	0	13.41	15.24	15.32	15.28	15.17	15.31	15.65	15.80	15.77	15.83	15.62	14.58	13.76	15.07	15.62	15.14	10.90	15.65	15.25	11.08
GB	11.51	10.07	12.32	10.99	12.76	11.86	14.73	11.59	9.99	13.32	13.41	0	10.96	11.25	12.14	12.25	14.43	12.57	12.43	12.43	12.45	15.56	11.59	11.58	11.95	12.34	10.23	11.48	12.41	11.23	10.95
GR	2.66	3.64	1.75	3.32	2.14	3.22	15.29	1.61	7.06	2.27	15.24	10.96	0	2.03	1.64	2.84	13.64	1.89	1.90	1.90	1.89	14.04	2.68	3.08	3.10	2.77	1.77	1.63	1.89	1.31	2.57
HR	2.13	2.85	1.36	3.85	2.39	2.64	14.83	1.40	7.31	1.61	15.32	11.25	2.03	0	1.42	2.09	14.61	1.33	1.32	1.31	1.37	14.94	2.75	2.82	3.29	2.65	1.23	2.12	1.39	1.30	2.39
HU	2.30	3.92	0.64	3.55	1.17	2.60	15.25	1.01	7.55	1.17	15.28	12.14	1.64	1.42	0	2.32	13.55	0.75	0.84	0.86	0.84	14.10	2.42	2.52	2.79	2.24	1.20	1.69	0.73	0.79	2.65
IE	2.58	4.17	2.32	3.68	2.83	3.34	14.65	1.89	7.47	2.66	15.17	12.25	2.84	2.09	2.32	0	13.63	1.56	2.35	2.32	2.34	13.23	1.45	2.40	3.47	3.12	1.30	2.48	2.33	1.73	3.10
IT	14.02	12.48	13.86	15.59	14.72	12.64	12.46	14.78	10.40	15.42	15.31	14.43	13.64	14.61	13.55	13.63	0	14.05	13.78	13.86	13.89	15.06	13.21	12.80	13.24	13.73	16.21	15.85	13.83	14.48	15.23
LT	2.22	4.13	0.22	3.84	1.60	2.69	15.55	0.41	7.99	0.64	15.65	12.57	1.89	1.33	0.75	1.56	14.05	0	0.31	0.22	0.24	13.98	2.35	2.80	2.82	2.33	0.33	1.94	0.34	0.35	2.80
LU	2.21	4.10	0.35	3.93	1.62	2.62	15.56	0.34	7.78	0.68	15.80	12.43	1.90	1.32	0.84	2.35	13.78	0.31	0	0.24	0.20	14.32	2.70	2.91	2.76	2.30	0.22	1.99	0.40	0.43	2.84
LV	2.16	4.07	0.31	3.90	1.69	2.66	15.59	0.40	7.88	0.66	15.77	12.43	1.90	1.31	0.86	2.32	13.86	0.22	0.24	0	0.18	14.29	2.70	2.88	2.79	2.30	0.25	2.00	0.35	0.40	2.85
MT	2.24	4.16	0.27	3.93	1.67	2.71	15.64	0.35	7.90	0.69	15.83	12.45	1.89	1.37	0.84	2.34	13.89	0.24	0.20	0.18	0	14.36	2.72	2.94	2.81	2.31	0.19	2.01	0.37	0.43	2.88
NL	13.39	12.05	14.30	11.73	13.46	13.09	13.24	14.73	11.77	14.08	15.62	15.56	14.04	14.94	14.10	13.23	15.06	13.98	14.32	14.29	14.36	0	12.82	12.85	13.10	13.45	15.54	13.83	14.14	14.64	13.89
NO	3.08	3.56	2.60	3.48	2.60	3.32	14.04	2.63	6.60	3.02	14.58	11.59	2.68	2.75	2.42	1.45	13.21	2.35	2.70	2.70	2.72	12.82	0	1.79	3.55	3.20	2.10	2.85	2.64	2.43	2.97
PL	3.18	3.38	2.81	3.57	2.65	3.06	13.58	3.13	6.91	2.95	13.76	11.58	3.08	2.82	2.52	2.40	12.80	2.80	2.91	2.88	2.94	12.85	1.79	0	3.61	3.23	2.86	3.00	2.81	2.88	3.12
PT	3.51	4.13	2.80	3.42	1.22	1.81	15.08	2.87	6.88	1.24	15.07	11.95	3.10	3.29	2.79	3.47	13.24	2.82	2.76	2.79	2.81	13.10	3.55	3.61	0	3.55	1.31	1.53	2.71	2.90	2.47
RO	2.36	3.67	2.26	3.51	2.93	3.36	15.04	2.58	7.92	2.72	15.62	12.34	2.77	2.65	2.24	3.12	13.73	2.33	2.30	2.30	2.31	13.45	3.20	3.23	3.55	0	3.16	3.24	2.23	2.47	3.72
RS	2.68	2.98	0.42	4.26	1.80	1.75	16.28	0.30	7.11	0.11	15.14	10.23	1.77	1.23	1.20	1.30	16.21	0.33	0.22	0.25	0.19	15.54	2.10	2.86	1.31	3.16	0	2.25	0.49	0.49	2.39
SE	2.40	3.00	1.87	2.53	1.99	2.34	15.73	2.05	6.04	2.03	10.90	11.48	1.63	2.12	1.69	2.48	15.85	1.94	1.99	2.00	2.01	13.83	2.85	3.00	1.53	3.24	2.25	0	1.98	1.69	2.22
SI	2.02	4.05	0.35	3.72	1.54	2.54	15.53	0.48	7.87	0.70	15.65	12.41	1.89	1.39	0.73	2.33	13.83	0.34	0.40	0.35	0.37	14.14	2.64	2.81	2.71	2.23	0.49	1.98	0	0.51	2.90
SK	2.13	3.04	0.34	3.65	1.60	2.55	15.35	0.53	7.16	0.47	15.25	11.23	1.31	1.30	0.79	1.73	14.48	0.35	0.43	0.40	0.43	14.64	2.43	2.88	2.90	2.47	0.49	1.69	0.51	0	2.51
TR	3.19	1.95	2.77	3.40	2.33	2.43	15.68	2.88	5.32	2.87	11.08	10.95	2.57	2.39	2.65	3.10	15.23	2.80	2.84	2.85	2.88	13.89	2.97	3.12	2.47	3.72	2.39	2.22	2.90	2.51	0

Source: own elaboration by the authors.

The following figure demonstrates a division of the countries according to all environmental protection activities that are covered by the explored data set.

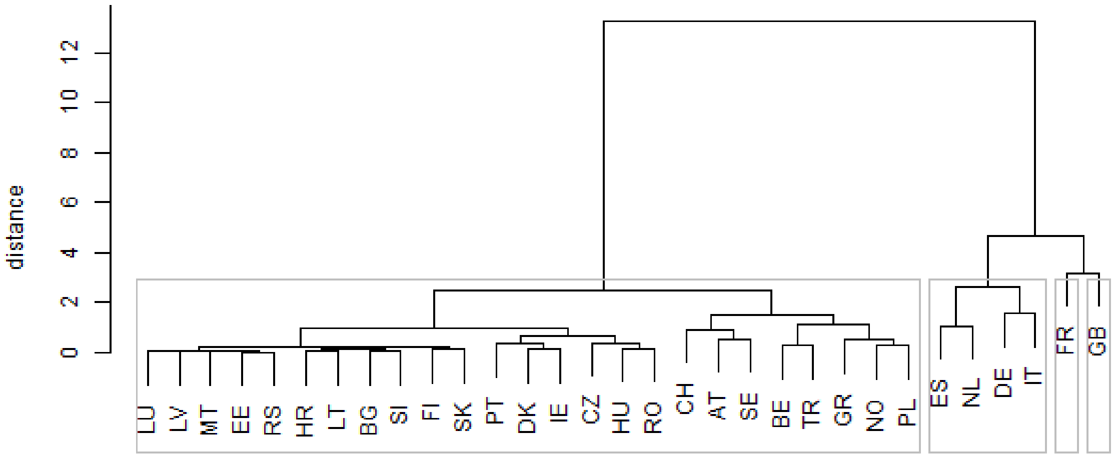


Fig. 2: The Dendrogram of All the Environmental Protection Activities
Source: own elaboration by the authors.

Comparing the dendrogram of all environmental protection activities to the first one devoted to all the individual sections of the environmental protection activities, the differences are seen. A basement of the distribution of the participated countries has a similar pattern – the same more developed countries are kept together. The first cluster is the substantial, and it involves the 25 countries – Luxembourg, Latvia, Malta, Estonia, Serbia, Croatia, Lithuania, Bulgaria, Slovenia, Finland, Slovakia, Portugal, Denmark, Ireland, Czechia, Hungary, Romania, Switzerland, Austria, Sweden, Belgium, Turkey, Greece, Norway, and Poland. The second cluster is created by the four countries which Spain, the Netherlands, Germany, and Italy belong among. The last two clusters involve the sole countries – France and the United Kingdom of Great Britain and Northern Ireland separately.

Protection of Air, Climate, Soil, Water and Against Noise, Vibration, and Radiation. The first partial clustering process is applied in a field of protection of air, climate, soil, water and against noise, vibration, and radiation.

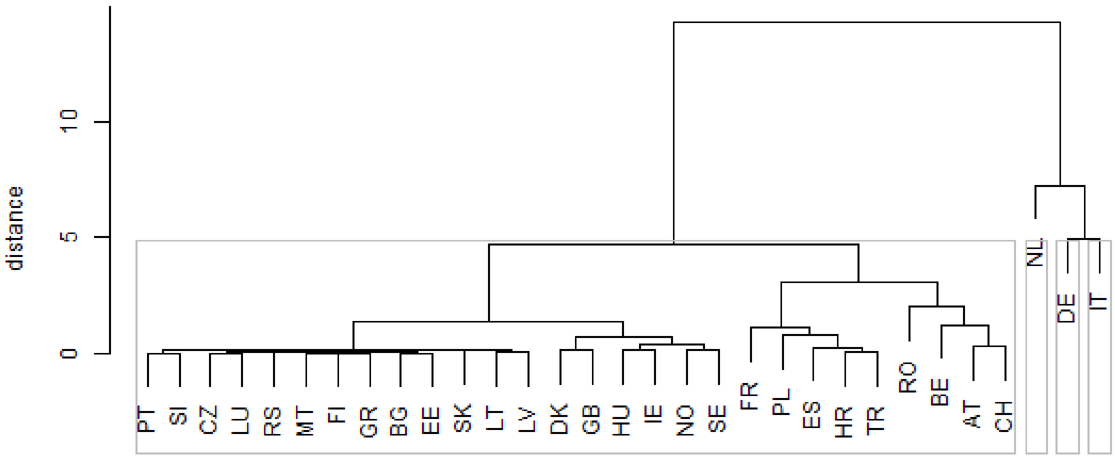


Fig. 3: The Dendrogram of Protection of Air, Climate, Soil, Water and Against Noise, Vibration, and Radiation
Source: own elaboration by the authors.

The uneven division is also confirmed in a field of protection of air, climate, soil, water and against noise, vibration, and radiation. The first cluster represents a substantial part of the whole data set, because it covers the 28 countries – Portugal, Slovenia, Czechia, Luxembourg, Serbia, Malta, Finland, Greece, Bulgaria, Estonia, Slovakia, Lithuania, Latvia, Denmark, the United Kingdom of Great Britain and Northern Ireland, Hungary, Ireland, Norway, Sweden, France, Poland, Spain, Croatia, Turkey, Romania, Belgium, Austria, and Switzerland. The two-part and also the four-part distinction of this cluster is clearly visible. The second, the third, and the fourth cluster are created only by the sole countries – successively, the Netherlands, Germany, and Italy.

Wastewater Management. The second partial clustering process is devoted to a field of wastewater management, and it is pictured on the succeeding dendrogram.

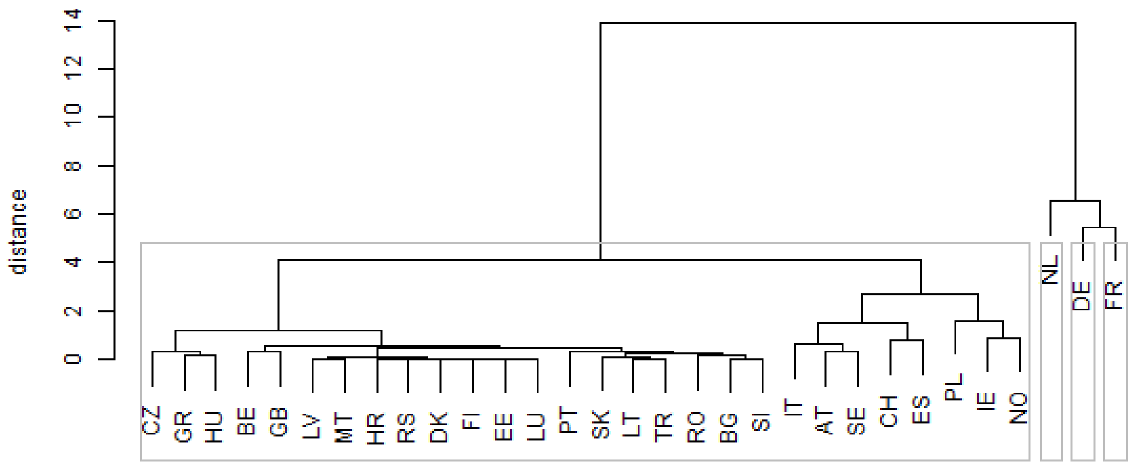


Fig. 4: The Dendrogram of Wastewater Management
Source: own elaboration by the authors.

Again, the very strong disproportion is seen in a clustering outcome distribution. The first cluster involves all the countries except for the three countries that create the separate clusters. The substantial cluster consists of the 28 countries which Czechia, Greece, Hungary, Belgium, the United Kingdom of Great Britain and Northern Ireland, Latvia, Malta, Croatia, Serbia, Denmark, Finland, Estonia, Luxembourg, Portugal, Slovakia, Lithuania, Turkey, Romania, Bulgaria, Slovenia, Italy, Austria, Sweden, Switzerland, Estonia, Poland, Ireland, and Norway belong among. The Netherlands, Germany, and France represent the three individual clusters.

Waste Management. The third partial clustering process covers a field of waste management which is illustrated by the following dendrogram.

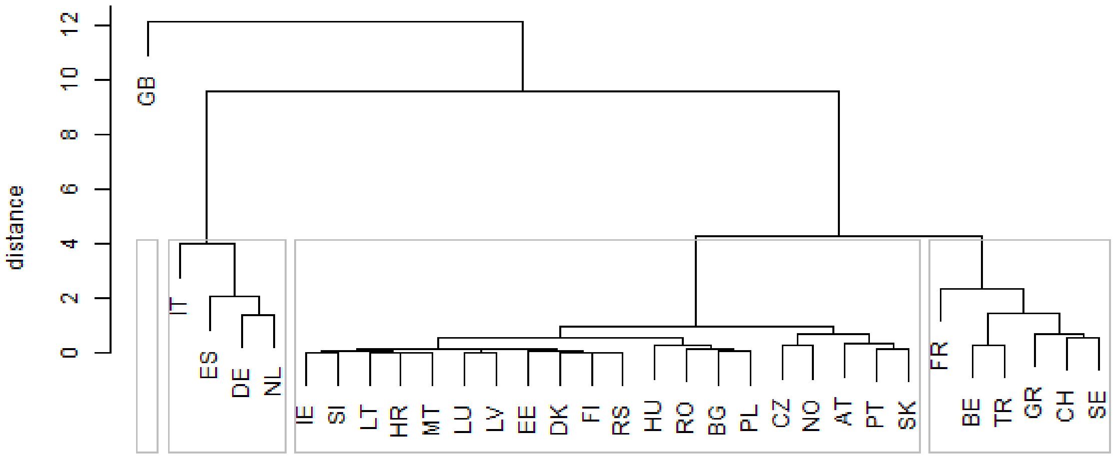
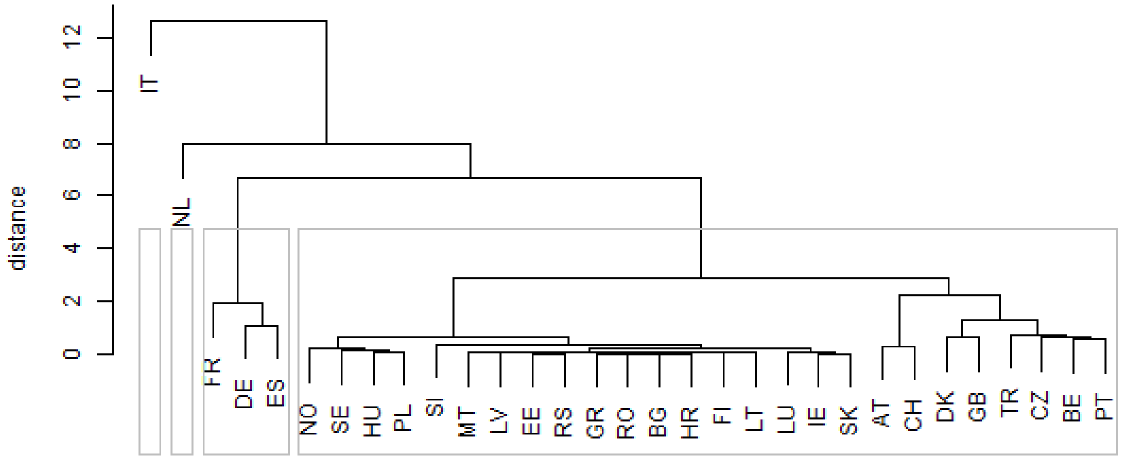


Fig. 5: The Dendrogram of Waste Management
Source: own elaboration by the authors.

Although the distribution of the countries is not so solid, the first cluster involves only a sole country – the United Kingdom of Great Britain and Northern Ireland. The second cluster covers the countries that are usually in the clusters characterised by a very low number of the participants. These are Italy, Spain, Germany, and the Netherlands. The third cluster presents the fundamental group which involves Ireland, Slovenia, Lithuania, Croatia, Malta, Luxembourg, Latvia, Estonia, Denmark, Finland, Serbia, Hungary, Romania, Bulgaria, Poland, Czechia, Norway, Austria, Portugal, and Slovakia. The fourth cluster covers the territories of France, Belgium, Turkey, Greece, Switzerland, and Sweden.

Protection of Biodiversity and Landscapes. The fourth partial dendrogram visualises a situation in a field of protection of biodiversity and landscapes.



Figô 6: The Dendrogram of Biodiversity and Landscapes
Source: own elaboration by the authors.

The key pattern of this clustering distribution is very similar to the first and the second partial dendrograms. Italy and the Netherlands represent the individual clusters, whilst the latter one repeats its role from the previous case. The third cluster consists of the three countries – France, Germany, and Spain. All the remaining countries, where Norway, Sweden, Hungary, Poland, Slovenia, Malta, Latvia, Estonia, Serbia, Greece, Romania, Bulgaria, Croatia, Finland, Lithuania, Luxembourg, Ireland, Slovakia, Austria, Switzerland, Denmark, the United Kingdom of Great Britain and Northern Ireland, Turkey, Czechia, Belgium, and Portugal belong, create the fourth cluster. Also, it is visible a potential separation within this cluster here.

Environmental Research and Development. The fifth fractional dendrogram envisages a situation in a field of environmental research and development.

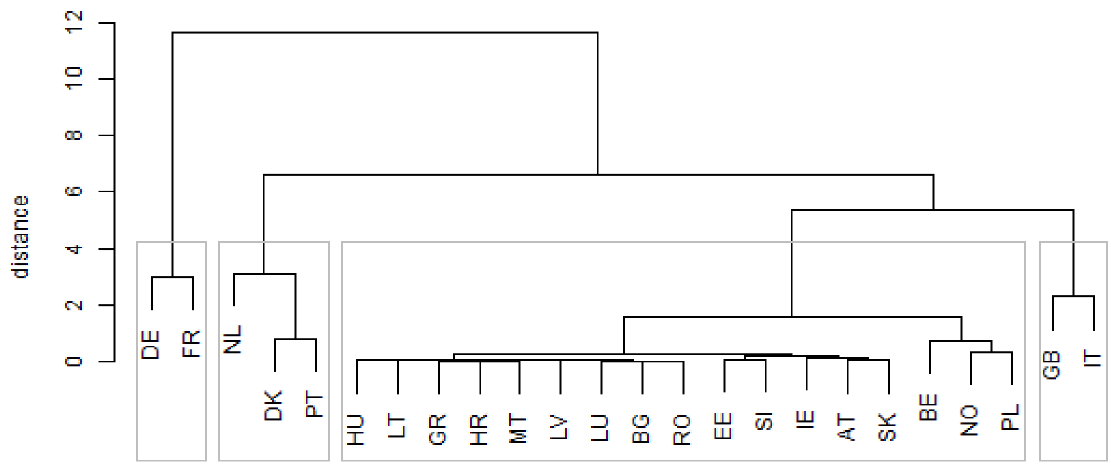


Fig. 7: The Dendrogram of Environmental Research and Development
Source: own elaboration by the authors.

Though there is no cluster with a sole country, the two of them involve only the two countries. The first cluster is created by Germany and France. The second cluster includes the Netherlands, Denmark, and Portugal. The third cluster is the largest one covering the 17 countries – Hungary, Lithuania, Greece, Croatia, Malta, Latvia, Luxembourg, Bulgaria, Romania, Estonia, Slovenia, Ireland, Austria, Slovakia, Belgium, Norway, and Poland. The fourth cluster covers the United Kingdom of Great Britain and Northern Ireland and Italy. There is to note that the seven countries, which Switzerland, Czechia, Spain, Finland, Serbia, Sweden, and Turkey belong among, are avoided in this clustering process because of the lack of the data in a field of the environmental research and development.

Other Environmental Protection Activities. The sixth partial clustering process illustrates the distribution of countries according to the data on the other environmental protection activities.

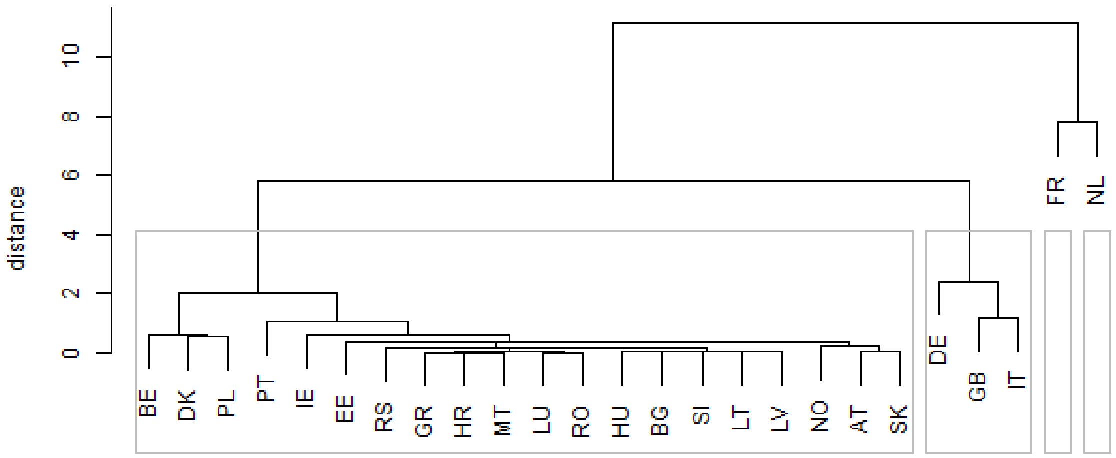


Fig. 8: The Dendrogram of Other Environmental Protection Activities
Source: own elaboration by the authors.

The other environmental protection activities data is represented by a very similar pattern as it is in the previous sections. The elementary pattern is clearly visible – a very large cluster and besides it the clusters with a very low number of the countries. The main cluster covers the territories of Belgium, Denmark, Poland, Portugal, Ireland, Estonia, Serbia, Greece, Croatia, Malta, Luxembourg, Romania, Hungary, Bulgaria, Slovenia, Lithuania, Latvia, Norway, Austria, Slovakia. The second cluster involves Germany, the United Kingdom of Great Britain and Northern Ireland, and Italy. The last two countries – France and the Netherlands – create their own individual clusters. As in the previous case, there is to note that the six countries, which Switzerland, Czechia, Spain, Finland, Sweden, and Turkey belong among, are removed from the clustering process because of the lack of the data in a field of the other environmental protection activities.

Differences Between the Explored Fields. The elementary differences between the individual dendrograms can be illustrated by the distances between the created clusters. The following table demonstrates the main intermediate distance between the pairs of the clusters in the second column successively, in the third column, the distance between the first cluster and the second cluster; and in the fourth column the distance between the third cluster and the fourth cluster.

Tab. 2: The Similarities of the Countries Within the Analysed Fields

Field	Intermediate distance	The first cluster to the second cluster distance	The third cluster to the fourth cluster distance
all the individual sections	30.2830	5.9855	16.0444
all the environmental protection activities	13.2181	2.4957	4.6271
protection of air, climate, soil, water and against noise, vibration, and radiation	14.2579	not applicable	4.9263
wastewater management	13.8662	not applicable	5.4581
waste management	12.0861	not applicable	3.9884
protection of biodiversity and landscapes	12.6225	not applicable	6.6814
environmental research and development	11.6445	not applicable	5.3683
other environmental protection activities	11.1278	5.8091	7.7733

Source: own elaboration by the authors.

There is to note that all the numbers are rounded to four decimal places mathematically. For all the cases of all the individual sections, all the environmental protection activities, and the other environmental protection activities, the involved countries are divided into the two hierarchical steps into the four clusters directly. The remaining cases are represented by the successive distribution into the particular clusters. Hence, the column of the first cluster to the second cluster distance is not available in these cases. It could be measured through the other distance, but this is not a substantial point in order to make a conclusion from this analytical approach.

As it is seen in the previous table, there are the very high numbers of the intermediates distances between the clusters. It is the most visible in a case of all the individual sections, where the Euclidean distance between the splits of the clusters reach a level of 30.2830. For all the other cases, this position is kept the numbers over a two-digit level from 11.1278 up to 14.2579. Besides these differences, there are visible the quite considerable dissimilarities also between the separate clusters. In a case of all the individual sections, there is the highest distance between the two particular neighbouring clusters at a level of 16.0444. This is a more dissimilar situation than all of the intermediate relations for all the other explored fields.

Differences Between the Clusters Participants. The large disparities within the whole data set are also demonstrated by the following table that shows the numbers of the countries participating in the cluster where the particular country lies.

Tab. 3: The Numbers of the Co-participants Within the Particular Clusters

Country	Individual fields	All fields	Field 1	Field 2	Field 3	Field 4	Field 5	Field 6	Average value of fields
AT	25	25	28	28	20	26	17	20	23.17
BE	25	25	28	28	6	26	17	20	20.83
BG	25	25	28	28	20	26	17	20	23.17
CH	25	25	28	28	6	26	17	20	20.83
CZ	25	25	28	28	20	26	17	20	23.17
DE	2	4	1	1	4	3	2	3	2.33
DK	25	25	28	28	20	26	3	20	20.83
EE	25	25	28	28	20	26	17	20	23.17
ES	3	4	28	28	4	3	17	20	16.67
FI	25	25	28	28	20	26	17	20	23.17
FR	3	1	28	1	6	3	2	1	6.83
GB	3	1	28	28	1	26	2	3	14.67
GR	25	25	28	28	6	26	17	20	20.83
HR	25	25	28	28	20	26	17	20	23.17
HU	25	25	28	28	20	26	17	20	23.17
IE	25	25	28	28	20	26	17	20	23.17
IT	2	4	1	28	4	1	2	3	6.5
LT	25	25	28	28	20	26	17	20	23.17
LU	25	25	28	28	20	26	17	20	23.17
LV	25	25	28	28	20	26	17	20	23.17
MT	25	25	28	28	20	26	17	20	23.17
NL	1	4	1	1	4	1	3	1	1.83
NO	25	25	28	28	20	26	17	20	23.17
PL	25	25	28	28	20	26	17	20	23.17
PT	25	25	28	28	20	26	3	20	20.83
RO	25	25	28	28	20	26	17	20	23.17
RS	25	25	28	28	20	26	17	20	23.17
SE	25	25	28	28	6	26	17	20	20.83
SI	25	25	28	28	20	26	17	20	23.17
SK	25	25	28	28	20	26	17	20	23.17
TR	25	25	28	28	6	26	17	20	20.83

Source: own elaboration by the authors.

The average value is rounded to the two decimal places mathematically. The fields are numbered according to their order stated in the methodology section. The numbers of the coparticipants in the particular clusters clearly demonstrate which countries can be classified as almost the sole ones in the individual clusters. The absolutely lowest average value of coparticipants is reached by the Netherlands at a level of 1.83, whilst this country reaches the individual cluster as its sole participant for four times. The second position with an average value of 2.33 is occupied by Germany. It creates its own individual cluster for two times. The third place with a little offset is kept by Italy at a level of 6.5. Again, its own individual cluster is created for two times. Just right behind it, France follows on the fourth position with an average value of 6.83 and completing two own individual clusters. After these four countries, there is a considerable offset followed by the United Kingdom of Great Britain and Northern Ireland with an average value of 14.67. It is the country with the highest average value of the coparticipants in the clusters that creates its own individual cluster, although only for once. The sixth place is held by Spain with an average value of 16.67. All the remaining countries keep their average values over a twenty-coparticipant threshold.

Discussion

The analysis demonstrates the considerable differences between the explored participating countries. This is the fact that should be investigated further. The aim of this paper is to point out there are the significant inconsistencies among the European Union member countries, the European Free Trade Association and the other countries that act as the potential European Union member candidates. It is a crucial point which has to be revealed in order to implement the regulations which would lead to more efficient spending of the financial resources in a field of the environmental protection services generally. Here, it is observed from an angle of view of the governments of the explored countries and therefore, it is perceived from the population of these countries more sensitively.

Policy plays an important role in environmental issues. Whether it is related to air, climate, soil, water, or waste, it is the key element in the process of protection environment for future life. Besides all the partial fields, environmental research and the development activities in this research perform very considerably too, along with the other environmental protection activities.

Mitigation and adaptation are the two mainstreamed policy fields that are required to be integrated into the existing sectoral policies. A key aim of jointly institutionalising mitigation and adaptation should be ready to reduce conflicts, ambiguity and inconsistencies how to handle the current issues in combination with the other policy contents. In a case of the climate change adaptation, administration related to it is considerably difficult. The climatic issues should be included in daily practice by the consistent actions with the existing sectoral policies. As the analysis carried out for this paper demonstrates, climate with the other air and similars issues possesses an existence of the individually positioned clusters itself, which the Netherlands, Germany, and Italy among. Processes and means aimed at a reduction of the coherence problems between the sectoral policies and the climate policies have to be introduced (Göpfert et al., 2019).

Nowadays, there is an urgent need for integrated modelling studies. Here, a potential platform is offered to be created in order to develop a further investigation of the new issues not only in a field of water and soil together. The general circulation model is one of the possible solutions of such hydrologic question. Unambiguously, the representation of land usage change caused by the climate alteration throughout the certain period is interpreted in a more comprehensive way than in the past, since the indirect impact of land usage caused by this climate alteration is more substantial in comparison with the direct impacts (Li and Fang, 2016). A large variety of inputs can perform in the mentioned succession (Purakayastha et al., 2019). Similarly, it is very demanding on an opinion of each involved government.

A country perspective is an important part of the whole gear train. In a field of the soil issues multiplicatively. There are still the countries that have no regulations for soil protection – Austria and Sweden mainly, whilst Ireland and Slovenia only partially, and France merely indirectly. On the other hand, Germany, Italy, the Netherlands, Portugal, Romania, Slovakia, and a little bit unexpectedly Luxembourg regarding its area and geographical conditions apply plenty of the legal acts in this field. Bulgaria, Croatia, Czechia, Denmark, Estonia, Finland, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Spain, and the United Kingdom of Great Britain and Northern Ireland have the regulation that stands at a national level (Ronchi et al., 2019). Their positions in the cluster analysis are influenced by this naturally.

These findings constitute a strong platform for potential subsequent research in this area. They contribute to the larger system individually (Schönhart et al., 2018). The research ambition is to conduct a structural analysis of the investigated environmental activities and hence, to define causal relationships and research trajectories that reflect the extent of the economic and legislative measures in the individual countries, the impact of the demographic structure on the environmental activities, the impact of the environmental burdens on economic and social causes of the environmental disparities within these countries, etc.

Conclusion

Ensuring a sustainable environment as well as protecting natural resources represent the key environmental policy objectives that require actions at all the levels of management. Environmental protection is directly linked to the competitiveness of the individual country. The environmental policy supports labour position creation, investment promotion and innovation development. Environmental indicators are applied to measure the efficiency and effectiveness of the environmental activities, which are now part of many decision-making mechanisms. Their important role is also informative. Many international institutions assess countries from the perspective of environmental activities and also assess the impacts of industry, transport and construction. An impact evaluation of legislative, economic and incentive instruments is also important, which encourages the linking of economic, social and environmental policies. The evaluation systems require the accessibility of the international databases containing the indicators quantifying the several environmental activities of the European countries. They create a space for the multivariate comparative analyses. This is also the motive to carry out our research, which is aimed at analysing and evaluating the disparities in the environmental activities of the selected countries in the time period from the year 2006 to the year 2016. The cluster analysis is applied in order to process the available data. The six areas are examined – namely protection of air, climate, soil, water and against noise, vibration, and radiation, wastewater management, waste management, protection of biodiversity and landscapes, environmental research and development, and other environmental protection activities. The outcome shows the significant disparities in the environmental areas of the individual countries. As it is seen from the distribution of the countries among the clusters, there are the sole countries, which behave considerably dominantly often. Also, among the most numerous clusters, the countries with the larger outputs appear beside the other similar countries. This reveals partial inefficiency that should be a subject of the further research – for instance, France and the United Kingdom in protection of air, climate, soil, water and against noise, vibration, and radiation, Austria and the United Kingdom in wastewater management, Austria in waste management, Austria and the United Kingdom in biodiversity and landscapes, Austria and Belgium in environmental research and development, and these two countries also in the other environmental activities too. The results of the analyses represent a valuable platform for national policymakers as well as for developing national and international benchmarking indicators in this area.

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